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An Interactive Microcomputer-Based Kiosk Providing Energy Efficient Building Design Information

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ABSTRACT

Lawrence Berkeley Laboratory (LBL), with support from Southern California Edison (SCE), a major utility in the Los Angeles area, has developed a prototype electronic interactive Energy Information Kiosk: a personal computer with touch screen provides information linked to video images stored on an optical disc. The kiosk uses text, graphics, animation, sound, and video to communicate effectively. This project's goals were: to demonstrate SCE's commitment to provide relevant, useful energy services to its customers; to highlight specific incentive programs; to provide users with contacts to people and resource materials at SCE; and most importantly, to provide technical guidance for building design professionals who want to improve the energy efficiency of buildings.

INTRODUCTION

Recent major advances in microcomputers, optical disc, video, and audio technology, along with the development of innovative authoring software, create a unique opportunity to enhance the way individuals teach and learn. Instead of a traditional one-dimensional linear approach to training, we can now use "non-linear, interactive" techniques that complement each other. This multidimensional learning environment is called "interactive multimedia."

Interactive multimedia became a reality with the development of personal computers in the early 1980s and hardware and software that facilitated simplified object-oriented programming, creation of sophisticated computer graphics, digitization of sound, and interface with external imaging devices. These capabilities can stimulate the creative process, and require a multidisciplinary approach to developing any particular project.

Figure 1 diagrams a typical multimedia input, control and display, and output configuration. Input devices consist of still cameras and still and motion video cameras, image scanning devices, gray scale and color frame grabbers, and sound input digitizers. Control and display devices are the computer, optical disc player, and associated monitors; output capabilities include printed material, audio, and direct communication using a telephone and modem.

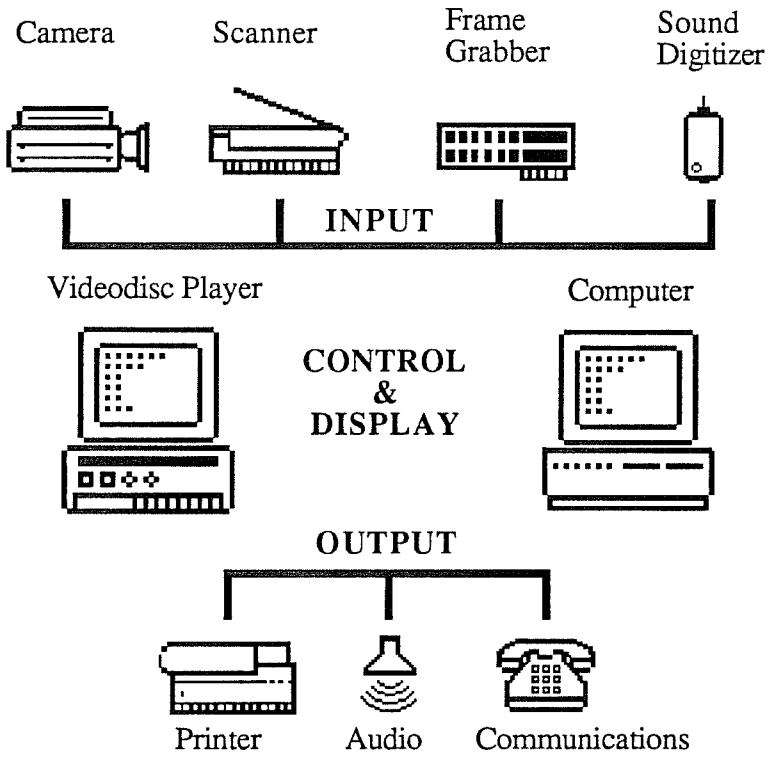

Fig. 1. Typical multimedia hardware configuration.

For the past twelve years, the Windows and Daylighting Group at Lawrence Berkeley Laboratory has been researching the energy and comfort performance of window systems. We have developed new glazing materials and defined new methods to analyze fenestration systems, so that critical design decisions can be made more efficiently and accurately. We have also been exploring new methods of transferring technology to the building industry: developers, architects, engineers, and building owners.

This paper describes the development and implementation of an interactive multimedia information kiosk that provides guidelines for energy efficient building design. Special emphasis is given to the user interface, one that involves a minimum of keyboard inputs, is icon driven, graphically oriented, animated, and efficient.

BACKGROUND

LBL's initial involvement with multimedia concepts research is described in a paper by Selkowitz, et al.,[1] which describes an advanced computer-based building envelope design tool, consisting of an interactive workstation. Both qualitative and quantitative aspects of the building design process were accommodated in this design tool. The concept involved using images (buildings, landscapes, models, documents, etc.), expert systems (knowledge bases, i.e., lighting design, site planning, HVAC design, etc.), and data bases (design criteria, utility rates, climatic data, etc.) in addition to more traditional simulation models.

We also developed prototype design and analysis tools to explore the uses and limitations of multimedia for architects, engineers, etc. Schuman, et al.[2,3] describes a daylight design tool. In it, the designer uses a microcomputer for access to thousands of images stored on an optical disc. The microcomputer screen contains text, data, graphics, and/or images, as well as the linkage information for user-selected access to other screens. An object-oriented authoring computer language provides linkages among the various program parts. Before such authoring software was available, developers had to be familiar with lower level programming languages and special microcomputer software requirements for screen design and control; object-oriented software simplifies the developer's job.

Sullivan[4] discusses another prototype develped in 1989: a fenestration performance design tool that uses a graphically-oriented, user-friendly interface. The prototype is intended to be part of a much larger building envelope design tool that will interact directly with computer aided design (CAD) systems, simplifying the building design process. The program's unique features are: (1) the use of icons to drive selections made by the user, enabling immediate branching to and exploring of alternate parts of the program; (2) a library of images and tabular data representative of different building types and window and shading systems, so the user can make decisions and evaluate alternative configurations easily; and (3) the use of animation in displaying calculated results and explaining concepts, such as daylighting and its effect on lighting performance. This program is one of the first uses of multimedia-based software for analysis of building energy and comfort performance.

The experience gained in these projects greatly assisted the effort required for creating an interactive multimedia energy information kiosk for the major utility in the Los Angeles area, Southern California Edison.

KIOSK DESCRIPTION

The kiosk is currently being used at Southern California Edison's Customer Technology Application Center (CTAC) in Irwindale, California. It is part of a large exhibit designed to inform Edison's customers about new, energy-efficient technology. The audience for the kiosk includes SCE staff, building owners and developers, and building industry professionals—architects, engineers, lighting designers, facility managers, contractors and builders, operations staff, and product manufacturers and distributors. The kiosk prototype unit will be evaluated for a variety of uses including operation of exhibits, and in interactive workshops in an adjacent theater.

In addition to use at CTAC, the interactive kiosk could be placed in regional utility offices, at exhibitions, and in educational loan programs. In lobbies or public areas of regional offices, the kiosk would offer energy efficiency information to walk-in bill payers, designers, and builders. The kiosk could also reach many people at building industry trade shows and conventions. Secondary schools and colleges, as well as professional training programs and public interest groups, could use a utility kiosk loan program.

The kiosk consists of two 19" color monitors, one connected to a microcomputer and the other to an optical disc player. In the current configuration, both monitors are mounted on a desktop with the computer and optical disc player hidden from view. Authoring software controls what is presented on the computer screen, and access to the video images on the optical disc. The 8" optical disc can hold 24,000 single frame video images or about 13

minutes of motion video at the standard rate of 30 frames/second. The computer monitor has a touch-sensitive screen, which enables users to control the active portions of the screen by a touch of the finger, rather than by using a mouse or keyboard. Figure 2 shows a configuration setup similar to the CTAC on-line version.

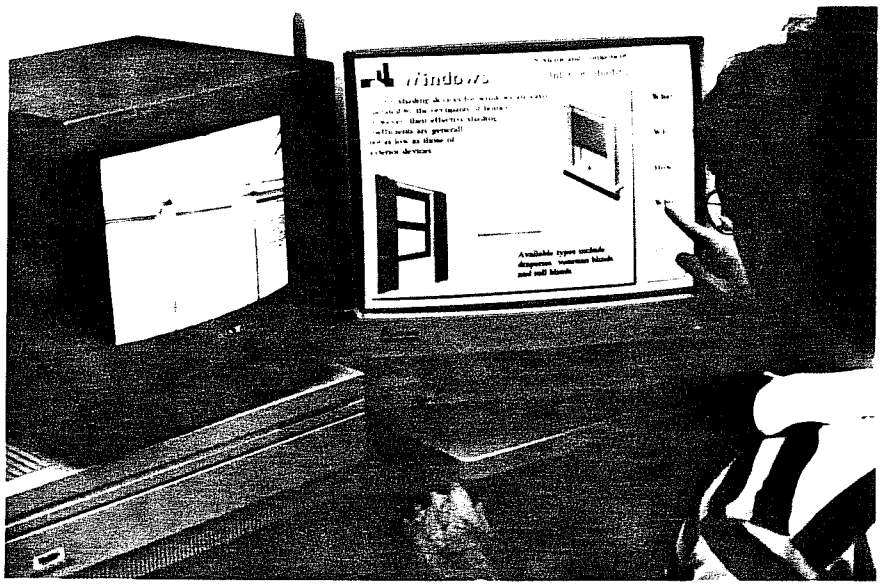

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Fig. 2. A typical kiosk user presses a button on the touch-sensitive screen to access information stored on the computer, which is linked with the optical disc images.

A friendly and intuitive user interface is the key innovation in this information kiosk. A user can select information from a wide range of topics simply by touching the computer screen. The amount of detail is controlled by the kiosk user. This multimedia-based technology supports extensive use of animation and video to explain concepts, which can help a user stay more interested in the presentation than simple text might. The kiosk can also provide hard copy output with an optional printer.

The kiosk has four primary information access points, as shown by the schematic presented in Figure 3: (1) an INTRODUCTION used to explain the purpose and operation of the kiosk; (2) a CONCEPTS path explains basic concepts used by the utility industry; (3) an INCENTIVES path discusses the utility's incentive programs for energy-efficient design; and (4) an ISSUES path presents detailed information about topics relevant to building design and energy efficiency, such as daylighting and electric heat pumps.

For users interested in the CONCEPTS path, information is available on: End Use, Demand Side Management, Rate Structure, Load Management, Energy Conservation, and Demand Forecasting. These six topics were selected to emphasize the utility's concern for proper management and conservation of resources. Future versions of the kiosk could include other topics. The INCENTIVES path treats three of the utility's incentive programs: Design for Excellence, New Construction Rebates, and Jointly-Funded Feasibility Studies. This part of the kiosk was intended to briefly explain these programs and direct kiosk users to sources of additional information. In the future, we envision directly linking kiosk users with SCE customer service representatives who could answer questions on the spot.

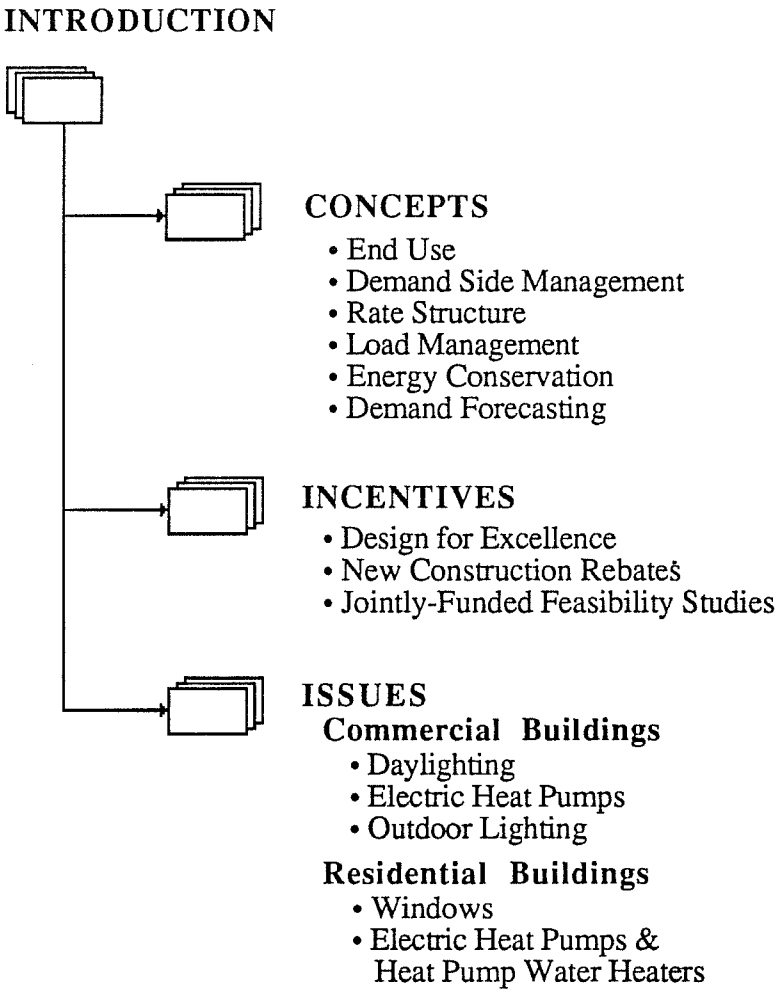

Fig. 3. Information structure of the kiosk.

The ISSUES path contains most of the energy-efficient building design information available to users. We have developed information for five topics: Daylighting, Electric Heat Pumps, and Outdoor Lighting in the commercial building area; and Windows and Electric Heat Pump and Heat Pump Water Heaters in the residential building area. Within each topic shown in Figure 3 are four data bases: WHAT (Information data base), WHY (Impact data base), HOW (Design data base), and WHO (Contact data base). The WHAT, WHY, and HOW subtopics are partitioned into sub-subtopics as indicated in Figure 4. The kiosk structure enables users to define their own paths and/or areas of interest. Within a particular ISSUE subtopic, a user can branch to any of the data base at any time.

The Information data base (WHAT) discusses the basic concepts, systems and components, operation, and performance parameters associated with a particular topic. Text and image selection stress basic principles and operation characteristics. The reasons for a designer to use a particular energy efficiency approach are given in the Impact data base (WHY). Items include energy, comfort, costs, and specific utility incentive programs that SCE is currently pursuing. Implementing and using a strategy are described in the Design data base (HOW). Design strategies, details, guides, tools, and case studies are presented.

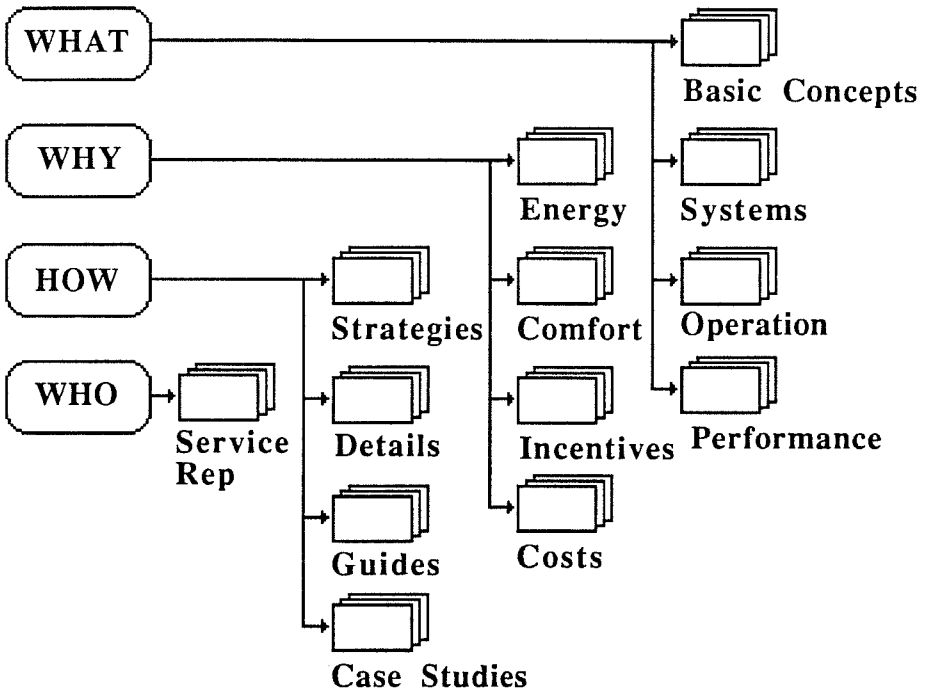

Fig. 4. Structure of the ISSUES portion of the kiosk.

An important part of the kiosk is the Case Study segment under the HOW menu, where we present examples of real-world buildings. This segment: (1) lists basic information about the building, such as location, architect, date of construction, and costs; (2) supplies a visual tour of the building using plan and elevation views on the computer monitor that are linked to photographic images on the video monitor; (3) shows specific design concepts associated with the building, so users can see immediately the effect of a particular energy efficient strategy; and (4) evaluates annual building energy performance.

The Contact Data Base (WHO) currently displays the SCE action line phone number for the customer service division. Future efforts will provide product lists as well as personnel contact information for manufacturers. We are also investigating the viability of a direct telephone and/or video link with such organizations and individuals.

Figures 5 through 8 show four screens from the kiosk presentation, two from the WHAT data base for Windows and two from the HOW data base for Heat Pumps. These images are in color in the on-line kiosk. Navigation and control are supplied by the buttons that are displayed along the left side of the screen. By simply touching a button, the user is automatically linked to another part of the program. Figure 5, which contains the menus for the WHAT data base, and Figure 7, which contains the menus for the HOW data base, display graphic images in the center of the screen that are also links to the specific data base that is annotated.

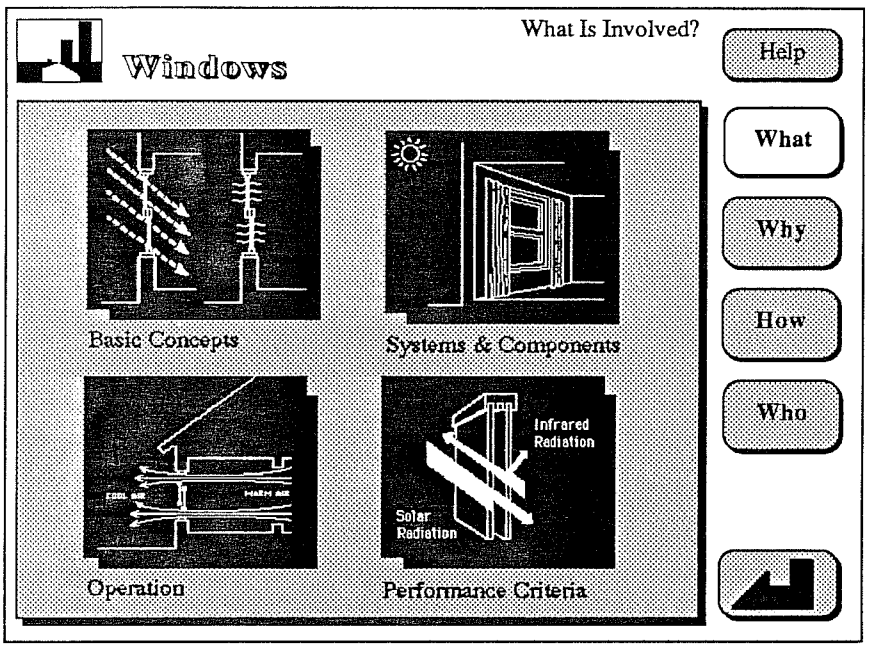

Fig. 5. "WHAT" menu for the residential windows portion of the kiosk.

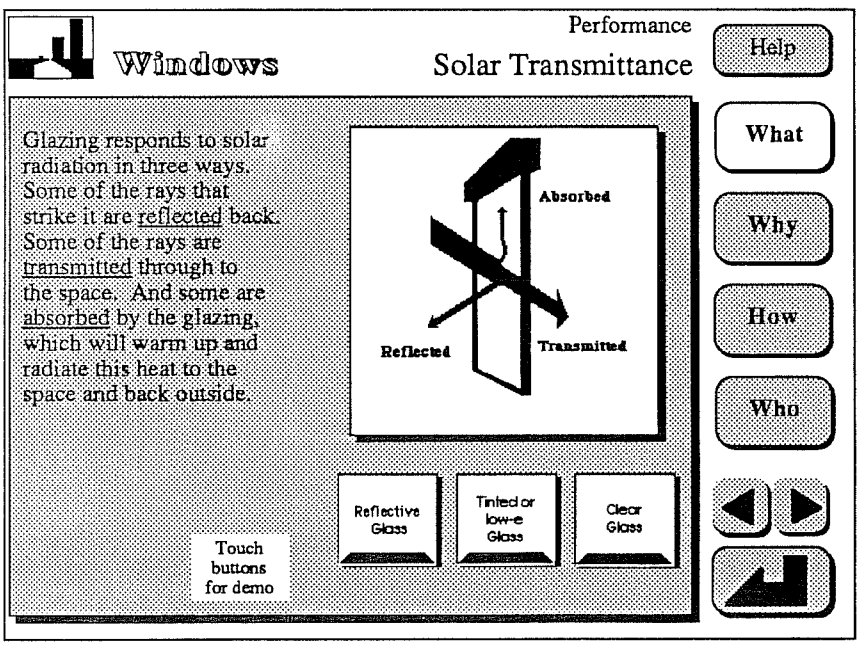

Fig. 6. Sample Screen from the residential windows portion of the kiosk.

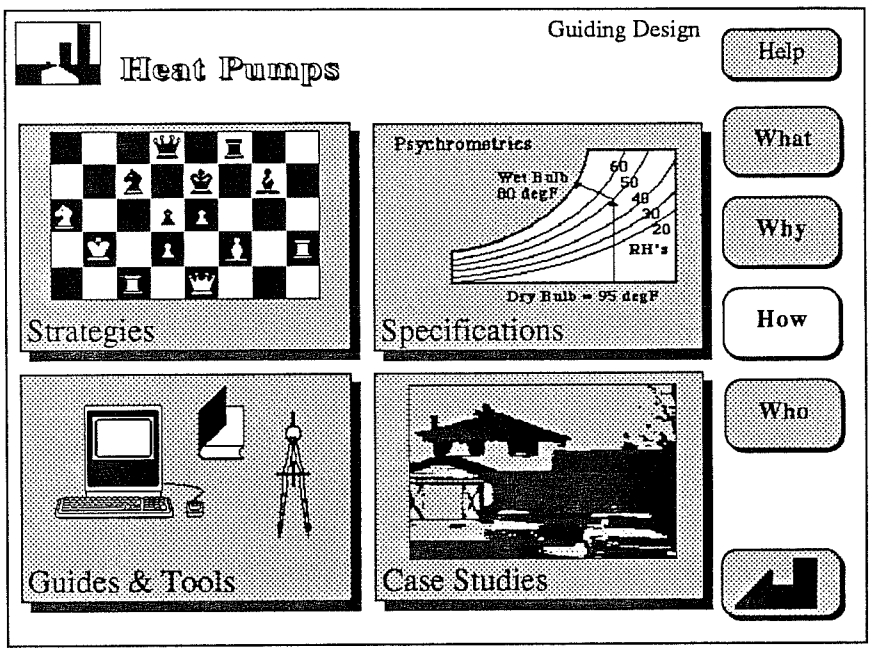

Fig. 7. "HOW" menu for the residential heat pump portion of the kiosk.

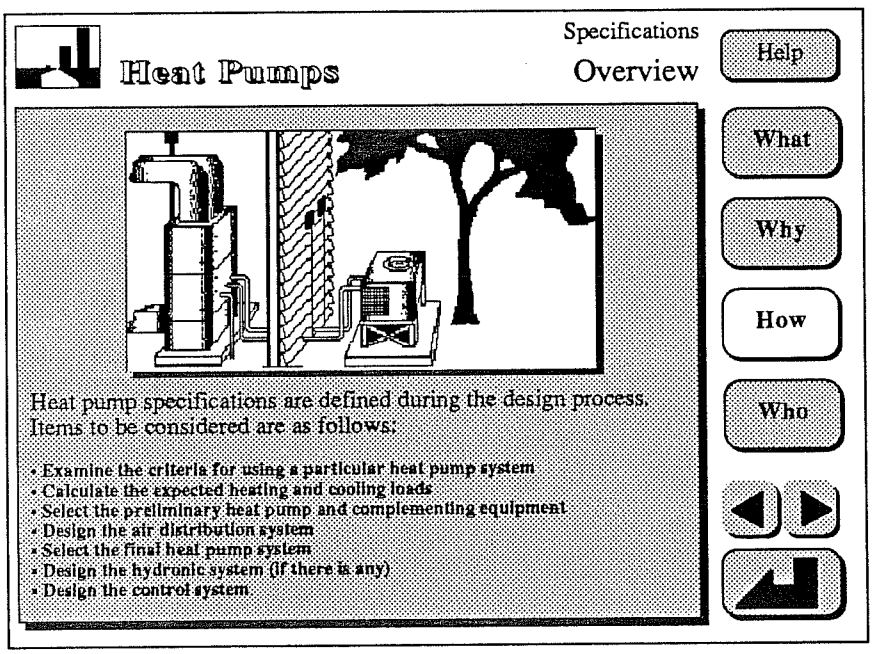

Fig. 8. Sample screen from the residential heat pump portion of the kiosk.

FUTURE DEVELOPMENT

The on-line kiosk is a prototype model that will be evaluated at CTAC and at LBL by several user groups during the next few months. The evaluation will address kiosk form, structure, interface, instructional content, function, screen presentations (text, color, graphics, animations, video imaging) and audio capability and usefulness. Users will be asked to respond to a questionnaire addressing the current and future goals of the kiosk; appropriate modifications will be made if necessary.

Our success with this project has stimulated numerous other ideas for future interactive information systems.

These include:

(1) developing building case study animated "walkthroughs" and evaluations using the linkage between the electronic information and a large data base of photographic images stored on an optical disc;

(2) developing a real-time phone or video communications link for expert advice from customer service staff;

(3) developing software to track user paths through the data base;

(4) evaluating single-screen versus dual-screen presentations;

(5) evaluating and creating similar kiosk capabilities on other microcomputer hardware and software systems;

(6) increasing the size of the data base to include additional elements related to commercial and residential building envelope, space conditioning, lighting, and appliance topics;

(7) creating separate, stand-alone kiosks for commercial, residential, and electric lighting areas;

(8) incorporating quantitative design tools that could address user requests for specific numerical answers to design questions.

As a national laboratory funded by the U.S. Department of Energy, we have spent more than a decade developing and translating mainframe building science research software for use on microcomputers by architectural and engineering audiences. Some of these tools and much of the design strategy information have been used to develop handbooks, guides, and articles for popular publications. We are now exploring the repackaging of this valuable knowhow using the multimedia approach designed in this paper to make the information easily accessible.

ACKNOWLEDGEMENT

An information kiosk such as described in this paper requires a great deal of effort by a great many people. A team effort approach must be used because of the various skills necessary for successful development of each module. The authors would like to thank the following individuals for their contribution to the Energy Information Kiosk:

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Chris Grim	LBL - Graphics/ Animation/Programming
David Hall	Freelance Voice Actor
Darren Holland	LBL - Graphics
Michael Kroelinger	Arizona State University - Outdoor Lighting
Donald Lee Mauritz	Cal Poly Pomona - Case Studies
John Newton	LBL - Graphics/ Animation
Werner Osterhaus	LBL - Heat Pumps
Catherine Petersen	Freelance Voice - Actress
Robert Roach	Cal Poly Pomona - Case Studies
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Jennifer Schuman	LBL - Daylighting
Osman Sezgen	LBL - Heat Pumps
Jeff Warner	LBL - Windows

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